

Continuous Monitoring and Assurance in a Real-Time Economy

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A. Continuous Auditing in a Digital Economy

a. Definition of Continuous Auditing

Introduction

Continuous Auditing (CA) has moved from being an academic concept to a state in which CA software is being developed and offered by private industry. Despite of the challenges faced, CA is to be the future of auditing, given the modern technology environment (e.g., ERP systems) and regulatory environment (e.g., Sarbanes-Oxley act).

Continuous auditing (CA) is defined as:

.... a methodology that enables independent auditors to provide written assurance on a subject matter, for which an entity's management is responsible, using a series of auditors' report issued **virtually simultaneously with, or a short period of time after**, the occurrence of events underlying the subject matter. (CICA/AICPA 1999)

Compared with the traditional financial statement audit, CA is more timely, more comprehensive, more accurate, and less costly. Essentially, the development of CA decreases the gap between audit and management operations. In the past, managers had access to data that was far more detailed and obviously timelier than the auditor, who came into the picture only at the year's end. But the technology underlying CA, especially ERP systems, allows auditors to see the same data as managers and at the same time—or even earlier, given their expertise in process monitoring. This has profound implications for whether auditing remains a device for ex-post verification or becomes a means of real-time monitoring. In any event, CA will give auditors access to streams of data that they never could obtain cost-effectively before. Audit methodologies will have to adapt to this explosion in the magnitude, level of disaggregated detail, and timeliness of data. With continuous auditing, auditors will have the unprecedented ability to transform auditing into a system for the continuous analytic monitoring of business processes.

A monitoring and Control Representation of a Real Time Economy

Economy

The real-time economy¹ is characterized with the evolution of business processes towards real-time response facilitated by sensors (that measure processes automatically), ERP systems (that integrate applications), XML technology (that creates interoperability), a monitoring and control layer (that creates automated feedback loop and actions alarms) and changed business processes (reengineered and de-constructed²). A monitoring and control representation model in Figure 1 entails 5 levels: 1) Structural level, data level, 3) relationship level, 4) analytic monitoring level, and 5) continuous reporting and assurance level.

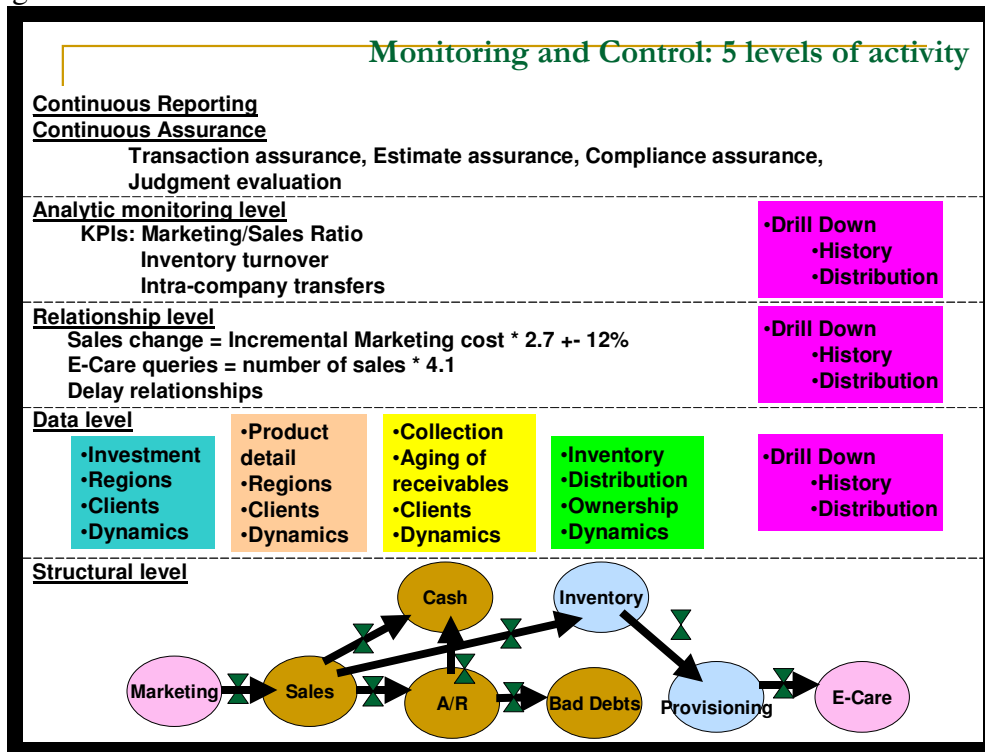


Figure 1: Monitoring and Control

A dynamic world cannot be well measured with static measurements, and technology exists for a more dynamic method of measurement to evolve.

The model described in Figure 1 encompasses an expanded view of the business enterprise and its monitoring, controlling, reporting, and assurance processes. This is a view coherent with a real-time economy and the necessary processes and levels of activity for its management. **The 5 level hierarchy represents a dynamic view of the world** where:

¹ Economist, The Real Time Economy, January 31, 2002.

² Vasarhelyi and Greenstein, The Electronization of Business, International Journal of Accounting Information Systems, 2003.

- 1) **processes exist** and exchange information using internal corporate data transfer methods, integrated ERPs and XML derivative transactions. These transactions and processes take time creating delays that must be taken into consideration.
- 2) the processes are measured creating a **data level** which most likely is a relational database that allows for selective extraction and analytic manipulation
- 3) similar to a spreadsheet individual data present **relationships** among themselves
- 4) in the absence or as a complement to the data level a much higher level of aggregation exists where systems use key performance indicators (KPIs) to **analytically monitor** high level process relationships
- 5) a meta higher level process uses the above for **continuous measurement and continuous assurance** at many levels

We are entering a real-time economy and reducing delay among and within processes gives competitive advantage. Therefore many processes and data transfers are being automated. Auditor must also automate their processes as well as rely on continuous measurements to be able to cope with this new world.

The Structural Level

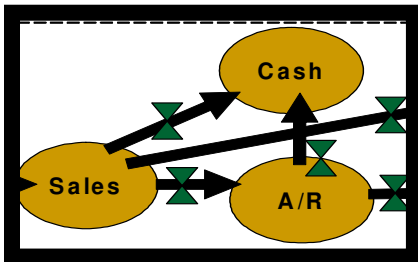


Figure 2: sales to cash

These processes take place in various areas of the business, and there are time lags both in their execution (intra-process lag) and between each process (illustrated by the hourglass shapes) called inter-process lag.

In the new real time economy, there is decreased delay between these processes, which makes it possible to achieve real-time or near real-time business activity monitoring and reporting. Automation greatly decreases the delay within and between of processes. The structural level represents a set of non-financial and financial processes that are interlinked in the generic process of wealth creation. There are physical and logical (statistical) relationships between the processes and between the different metrics of these processes.

Figure 2 is the process where a physical relationship exists propitiated by direct information flows. When a sale is performed it is either by direct cash being received or a receivable being generated. If the modeling of the process is to be performed in more

detail processes as inventory shrinkage, returns, quality control, repricing, etc... may be added. Structural linkages can be more complex and structural modeling can be extended to ensuing processes.

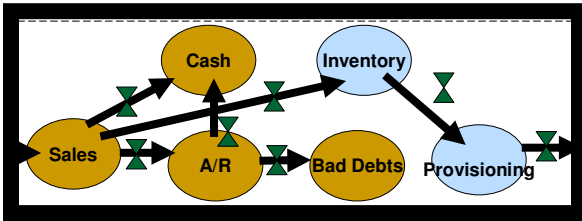


Figure 3: sales to cash inventory and bad debts

This representation can be mathematically modeled by now including the role of inventory payments in the depletion of cash and can be an input to the provisioning equations which drive inventory management and other functions. While this modeling focused on inflows of cash, assuming 3 period intervals, many different assumptions can be made.

Figure 3 displays a more realistic set of flows for cash, a core variable that is worth modeling, with timing differences and a feedback loop from inventory.

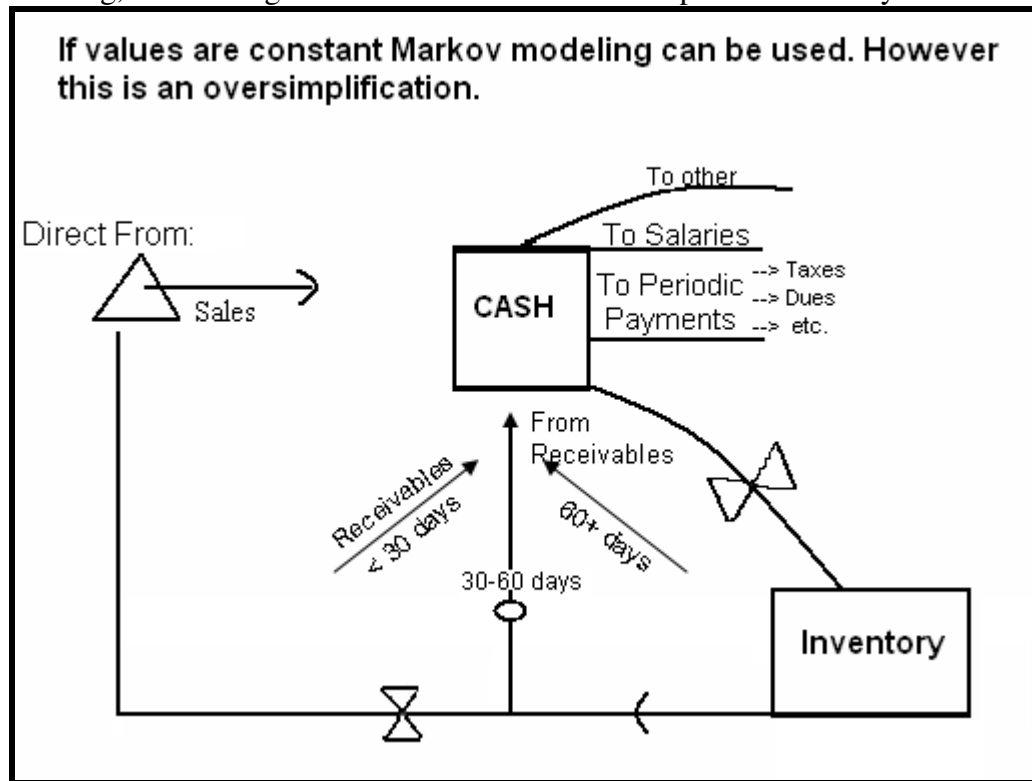


Figure 4: more complete cash structural model

However the structural level 1 includes processes that are not financial and not necessarily structurally linked. Logical relationships are effects that are not a direct consequence of management actions or direct data flows but relative to the business process. For example, marketing drives advertising that drives sales which drive inventory and provisioning (where physical factors such as obsolescence, shrinkage, and delays may have an effect), or even farther but still related processes such as e-care and

post purchase service driven sales. For these, some stochastic statistical models are to be built based on experience parameters. For example experience may say that for every dollar of advertising in the south region you generate 7 dollars of sales and in the northeast only 5. These considerations are represented in Figure 5.

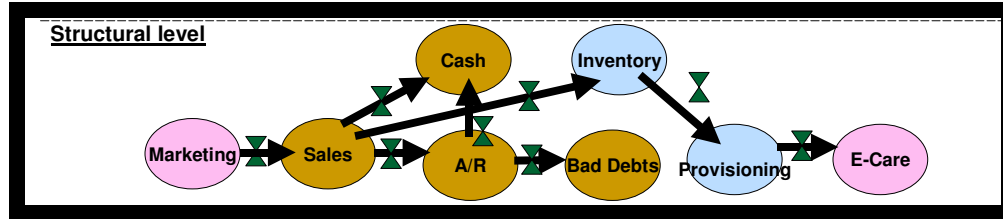


Figure 5: Level 1 - structural

The Data Level

The data level is where measurement of financial and non-financial indicators are accumulated after its sensing or observation at the structural (process) level. Individual pieces of data are stored and database organization and information technology provide the ability to drill down to look at historical performance and compare data across business lines, products, managers, etc. Most companies do this internally today through some form of spreadsheet analysis, but given the capabilities made possible through new systems and decreased latency between processes, which we discussed before, it is now possible through constant measurement to move to the relationship level.

The data level in the modern enterprise as described in Figure 6 entails many measurements of the processes as described above and as listed in the list of points-of-comparisons (POCs) for non-financial variables. Furthermore with the advent of databases, OLAP tools and style sheets, the “spreadsheet of measurement” of the modern enterprise incorporates the capability of drill-down (in finer details of the data structure, at the extreme into certain characteristics of a transaction such as amount or geography), accumulation of history not only of reported variables but also of desired aggregates (at the extreme say sales for a certain store) and distributional characteristics (ability to cut access parameters as geography, product or division).



Figure 6: Level 2 data

The Relationship Level

As in the spreadsheet analogy discussed above, cells are related one to the other. This third level discloses this set of relationships that may be of many different types. The existence of measured relationships between key variables allows the modern manager in a real-time society to make decisions understanding the structure / causes / and consequences in addition to historic information. These relationships can be

structural or stochastic. In Figure 7 the relationships involve sales and marketing, care queries and number of sales, and potential delay relationships.

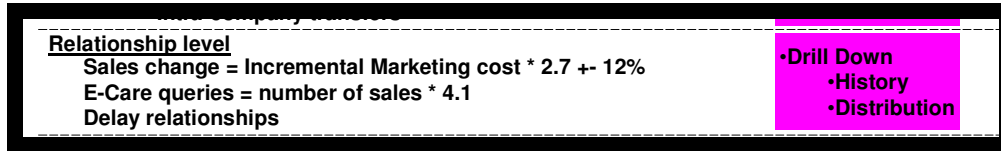


Figure 7: Level 3 – relationship

To further explain this level a balance sheet could be transformed and presented in sheet 1 of a spreadsheet while a model relating some of the variables would be in the second sheet and the user could calculate the variances in the third sheet. (see figure 9)

The disclosure of these relationships, in addition to being valuable by increasing reporting transparency and deterring reporting obfuscation would have valuable feed-forward effect motivating better modeling of business and improved self insight of causes and consequences of business numbers. Figure 8 and Figure 9 introduce different representations of the relationship level.

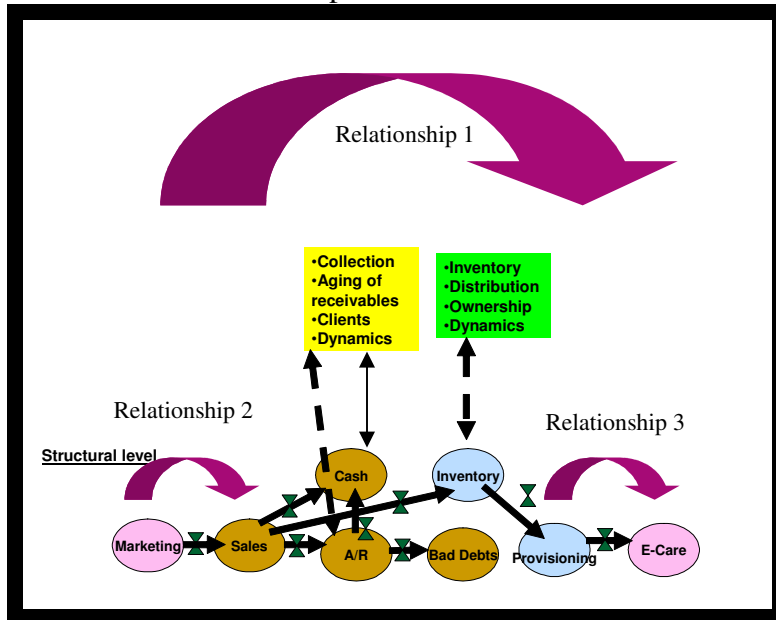


Figure 8: processes, measures and relationships

In Figure 8 relationship 1 relates marketing to e-care. This is an obvious relationship which parameters must be examined and estimated with care. In this relationship increased marketing leads to increased sales which ultimately increases the demand for e-care contingent on the effectiveness of advertising and sales efforts, the quality of the products, and the accessibility of the care. The care effort also leads to secondary sales. Relationships 2 & 3 are narrower and more direct.

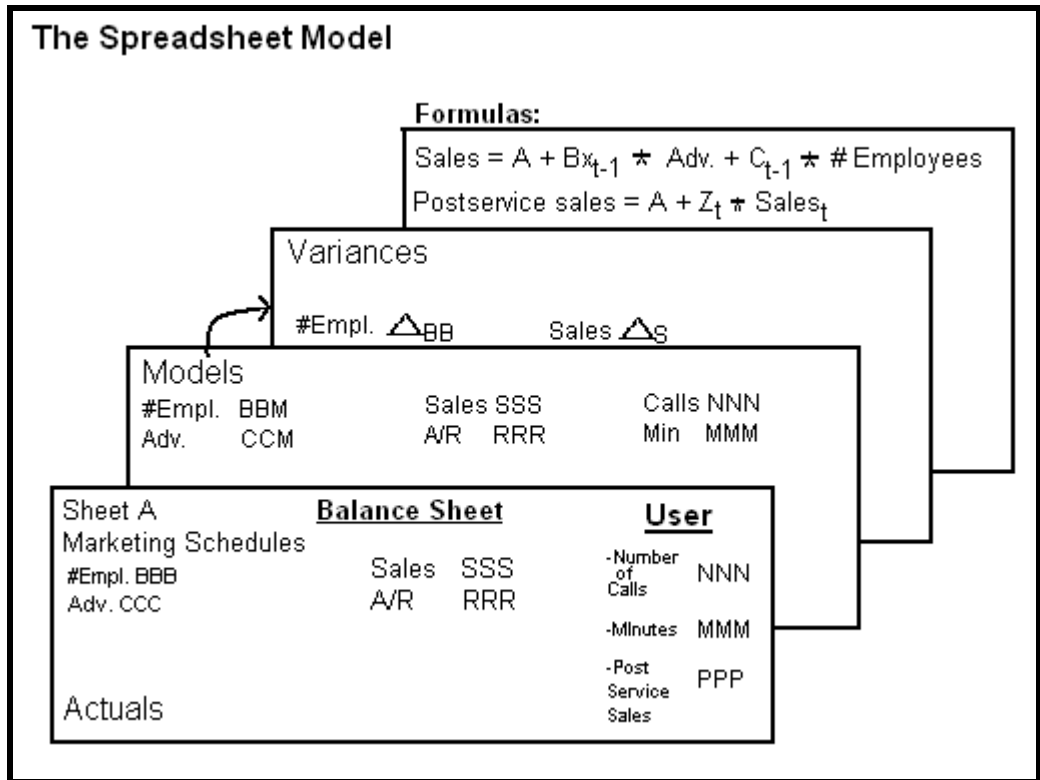


Figure 9: the spreadsheet disclosure model

While eventually most corporate systems will have extensive levels of detail and statistics enough to sustain substantial relationship-based monitoring, the Galileo model also has a higher level of relationship monitoring. This level is called analytic monitoring level and relies heavily on industry and company specific key performance indicators (KPIs). Level 4 (Figure 10) is both aimed at third party monitoring of corporate performance as well as internal monitoring in particular where information is not sufficient.

Companies monitoring their processes step by step may miss significant macro trends in their performance (missing the forest for the trees) and will benefit also for having the KPI monitoring level where better understanding of business is obtained. Executives will tend to focus on level 4, while live management and operational control managers (see Figure 10) will focus in level 3.

The Analytic Monitoring Level

In analytic monitoring, significant deviations from the norm for key performance indicators can be identified. This may indicate that a process is out of sync (such as...) even if detailed support may not exist. The next step would entail detailed analysis to capture the reason of misbalance. And of course you still have drill down capabilities at these levels, which can be extremely powerful.



Figure 10: Level 4 - monitoring level

The Continuous Monitoring, Reporting and Assurance Level

Finally, the continuous reporting and assurance level (Figure 11) ensure the reliability of systems and data, through transaction assurance, estimate assurance (on management projections), compliance assurance (compliance w/GAAP), and so on, which enables the entity to report important business information externally as well as internally with confidence. and so, what you have in the end, is a much more robust, automated reporting process is achieved that tells much more about the effectiveness of management, specific divisions, etc..., providing accurate and useful data on a real or near real-time basis.

Furthermore, XML tagging will enable interoperability, making it possible for connections across internal and external partnering entities.



Figure 11: Level 5 continuous reporting and assurance

The above real-time level of monitoring, reporting, control and assurance is achieved through a mix of technology and business process. This mix is reported in figure 12 which combines XML standards for data transfers, ERPS technology XBRL reporting technology, modeling for standard definition and decision making as well as a set of processes for continuous reporting and assurance.

Figure 12 displays three types of XML tagged transactions flowing into the organization, which can be metered by some form of continuous reporting that would display cumulative levels of flows in a chosen time period. For example, all labor purchases (even if not yet paid) for the first 44 days of the year. This data being delivered to the system carries some form of data level assurance (for example a measure of the reliability of its generating systems, or an encrypted tag with an auditor’s assurance) or relying on other forms of assurance of system integrity (e.g. systrust). This datum is delivered to the corporation’s ERPS under some form of XBRL/GL schema with a very detailed chart of accounts. The accumulated datum can, at any time, be queried for some form of level reporting (e.g. balance sheet) on a continuous or variable time basis. The ERPS support a large multitude of internal report, semi-internal reports and external reporting schema.

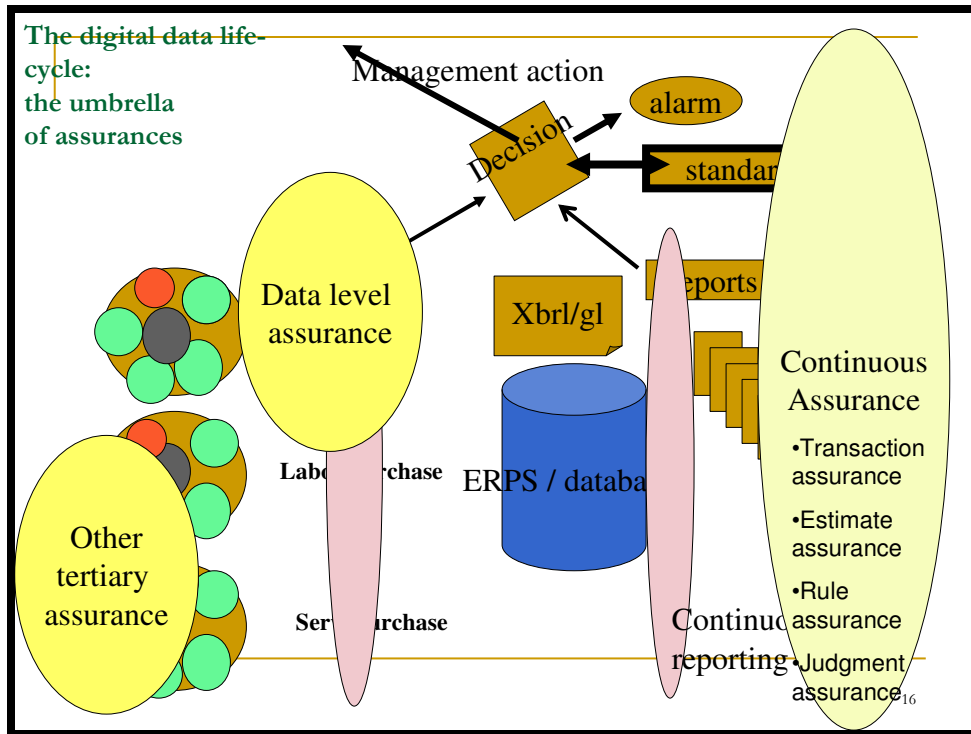


Figure 12: Continuous reporting and assurance

The above structure represents the key elements of a real-time economy management and control structure. Basic to this structure is the key management activity of control that entails a measurement of a business process, standards of activity (performance), and a decision structure that may be automatic or not typically activated by an alarm as depicted in Figure 12.

The basic activity of control always entails a measurement a standard, a variance and a decision on the significance of the variance for the process in question. These five levels of management activity are supported by the basic concepts of monitoring in a real-time economy.

Corporate processes under continuous assurance support: 1) transaction assurance (as described earlier), 2) estimate assurance, 3) rule assurance and 4) key judgment on process control assurance. These four continuous audit external audit support processes linked to a emerging **continuous control monitoring** technology will in the future provide three levels of assurance:

◆ **Data Level Assurance (DLA)**

–Develop innovative tools: control tags, cookie crumbs, control paths, aggregate estimates

◆ **Process Level Assurance (PLA)**

–Create a model that allows for the process by process estimate of control effectiveness

◆ **Opinion Level Assurance (OLA)**

–Develop temporal related continuous control effectiveness assessments

- Evergreen opinions
- Exception frames
- Probabilistic opinions

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Basic Concepts in Continuous Auditing

In order to implement continuous business activity monitoring, measurement and assurance five basic concepts must be defined, explored, and illustrated.

Metrics –

Metrics are defined as direct measurements of the system, drawn from direct sensing, databases and reports. These metrics are compared against system standards. If a standard is exceeded, an **alarm** appears on the screen. For example, in the auditing of a billing system, the number of bills to be invoiced is extracted from a user report. The number of bills not issued due to a high severity error in the data is captured as well as the total dollar amount of bills issued. These three numbers are metrics that relate to the overall billing process.

Standards or Models

Standards or models represent the ideal state-of-the-world in a particular process. Any monitoring process requires the comparison of a metric to a model or standard to determine abnormal conditions. Furthermore, the magnitude of this condition is evaluated by a “standard of variance” in the decision on whether an alarm should be activated. Models of variable behavior over time in real-time systems must be developed in a way that would represent real-time behavior of dynamic systems. The evolution of real time monitoring needs adaptive models that take into consideration: seasonality, business trends, relationships between processes, timing between the processes, and flow of anomalous but legitimate transactions process to process.

While the need and awareness about standards has been in the systems literature for a long time, the CPAS³ (Vasarhelyi & Halper, 1991) experience has indicated the need for a much more specific set of guidelines, not only about tolerance standards and expected traffic, but also for levels of error in relation to alarms and flow variations over time.

³ In the late 1980s AT&T Bell Laboratories developed the Continuous Process Auditing System (CPAS) to monitor and assure one of its large billers. It is not coincidental that this happened first at AT&T as it had been automatically collecting telephone calls with electronic switches since the late 70s.

Analytics –

Analytics are defined as functional (natural flow), logical (key interaction), and empirical (e.g. it has been observed that) relationships among metrics. Specific analytics, related to a particular system module can be derived from the auditor, management, user experience, or historical data from the system. Each analytic may have a several dimensions: 1) its algebraic structure, 2) the relationships and contingencies that determine its numeric value at different times and situations and 3) rules-of-thumb or optimal rules on the magnitude and nature of variance that may be deemed as “real variance” to the extreme of alarms. For example, a billing analytic would state that dollars billed should be equal to invoices received, minus values of failed edits plus (or minus) the change of the number of dollars in retained invoices. The threshold number of expected invoices for that particular day or week (allowing for seasonality) must be established to determine whether an alarm should be fired. For each level there are two types of analytics. Macro-analytics (that are used at level 4) refer to overall totals for each part of the system. (performance functions, population displays, dollar displays, message population displays). Micro analytics relate to a particular variable or part of a process. For example number of transactions in an error file and its time trends

Alarms –

Alarms are exception conditions where a measure and its standard are compared and the ensuing variance is larger than the variance standard. It is useful to represent alarms as objects with a multitude of attributes such as nature, level, addressee, form of warning, applicable conditions, etc.

Actual experience with these issues indicates that several levels of alarms are desirable:

- 1) minor alarms dealing with the functioning of the auditing system,
- 2) low level operational alarms to call the attention of operating management,
- 3) higher level alarms to call the attention of the auditor and trigger “exception audits” and
- 4) high level alarms to warn auditing and top management of serious crisis.

The data and experience needed to understand the phenomena being measured to the level of specification of alarm standards are probably not available in most organizations, still there is substantial experience with monitoring and control.

Method of Measurement

Method of Measurement: the method of data capture and classification is an important variable in the future system representation scenario. Continuously captured data can drive monitoring processes to real-time exception measurement and alarming.

The CPAS process captured data through report scrapping (Vasarhelyi & Halper, 1991) in electronic reports. Different monitoring processes are progressively capturing

data in many more direct manners such as data sensing, queries to databases or the utilization of intermediate data (Hume, 2001) between batch processes.

The monitoring and control function needs continuous assurance of transactions and processes. This control process is performed by comparing a system measurement (metric), with a standard and verifying the value of the variance. Analytic models are used to establish the level of relevance of the model and fire of different types of alarms

b. What is happening in business and software

CA is the product of a fundamental transformation in business operations and control. The digitization of companies through the widespread use of ERP systems, bar coding, the emerging radio ID (RFID) chips, and automated transaction recording makes it cheaper and easier to gather data at an unprecedented level of detail and with very little time lag following the transaction. In particular, the unique and unprecedented characteristic of ERP systems is that they seamlessly integrate and automate business processes to achieve real-time information flows.

The development of technology provides management and auditors with the ability to better capture and analyze key data for strategic and operational decisions. The use of intelligent agents embedded in audit modules to monitor and trigger alarms when unusual transactions or patterns occur provide management with tools to better monitor business processes. Auditors can now embed audit modules that test transactions and controls on a real-time basis. While the “electronization” of business processes has been actively pursued for several decades, and the implementation of modern ERP systems for over a decade, auditing has been slow to adapt to these environmental changes.

Several vendors are developing operations monitoring, control monitoring and analytic control evaluation tools. Among these we find ACL, Caseware, Auditronics, AuditMaster, Approva, Virsa, etc... The jury is still out if the monitoring and control layer will be independent software packages or a module of an ERPS tightly integrated with the applications.

Before Sarbanes Oxley it was likely that Big Five firms would use their consulting services to sell and install the monitoring and control layer for their clients and install libraries of monitoring algorithms which parameterization would be the equivalent of audit plans of the future. The current evolving model is independent monitoring and control packages and the auditor will have his/her private audit / algorithm libraries installed as part of the audit service. The business model of the future will probably involve a “ongoing monitoring fee” in addition to the traditional engagement billing. Alarm histories and their diagnostics will be part of audit evidence.

c. Linkages with Sarbanes Oxley

The financial crisis created by Enron, WorldCom, and others has turned a spotlight on a higher level of corporate governance and more rapid corporate reporting. The current reporting model is being heavily scrutinized due to significant regulatory reform measures implemented. The Sarbanes-Oxley Act and the SEC rules and regulations issued to supplement the Act are viewed as necessary reforms to restore public confidence in public reporting by corporate America. The Sarbanes-Oxley Act fundamentally changes all aspects of the financial and auditing environment. Most attention currently is focused on the Section 404 requirements concerning financial reporting controls. As a result, the spotlight is off another provision that could be equally momentous in its long run impact: the requirement built into Section 409 to move toward a system of real-time or continuous reporting. Specifically, Section 409 provides:

“Each issuer reporting under section 13(a) or 15(d) shall disclose to the public on a rapid and current basis such additional information concerning material changes in the financial condition or operations of the issuer, in plain English, which may include trend and qualitative information and graphic presentations, as the Commission determines, by rule, is necessary or useful for the protection of investors and in the public interest.”

We predict that, over time, Section 409 will lead to the adoption of reporting at times dictated by the needs of users of financial information and not by the constraints of the calendar. However, more frequent and timely reports will lack much of their power if users are not assured of their accuracy and dependability. Thus the impact of Section 409 will extend beyond reporting to bring about fundamental changes in the assurance industry.

However with the advent of the real time economy, its tooling, new demands on the assurance process and now the first major statutory expansion of the audit function through section # 404 assurance a new framework is emerging adding to the above definitional matter.

B. Continuous Control Monitoring (CCM)

a. Definition

The increased emphasis on controls mandated by Sarbanes Oxley created the need for expanding the conceptualization of CA and take advantage of 404 work. Furthermore at more advanced stages of 404 compliance, dealing with real time systems and their controls will be necessary. Eventually control monitoring results will be incorporated in an evergreen opinion that incorporates the observable controls, their functioning and the overall health of corporate systems detected by levels of CA. It is however necessary to integrate the audit evidence and assurance processes both of continuous control monitoring and transaction-based continuous assurance.

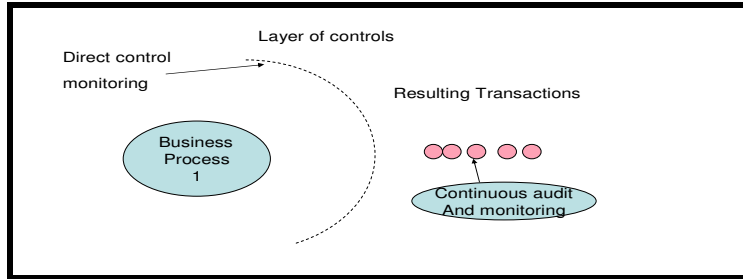


Figure 13: CA and CCM

Figure 13 represents a business process and its layer of controls. Some of these controls are directly observable and discrete others pervasive and not observable. For example many of the SAP controls are observable however controls such as supervision and training are less directly measurable. Out of the executed business process and its layer of controls transactions emanate and are transmitted to other business processes and/ or entities. These transactions are monitored and audited in a CA process both at an individual as well as different level of aggregation.

b. Detected error and their source controls

Defects detected in the transaction flow are, in most cases, an indication of control defects. This joint work of CA and CCM processes is contingent on the degree of automation of corporate processes, technology used, and degree of automation of the corporate assurance processes. If controls are inadequate and they cannot be directly monitored, the monitoring of resulting transactions and the detection of faulty transactions in the error string will indicate control weaknesses. Furthermore with the monitoring and analysis multiple error strings more complex error combination weaknesses can be identified.

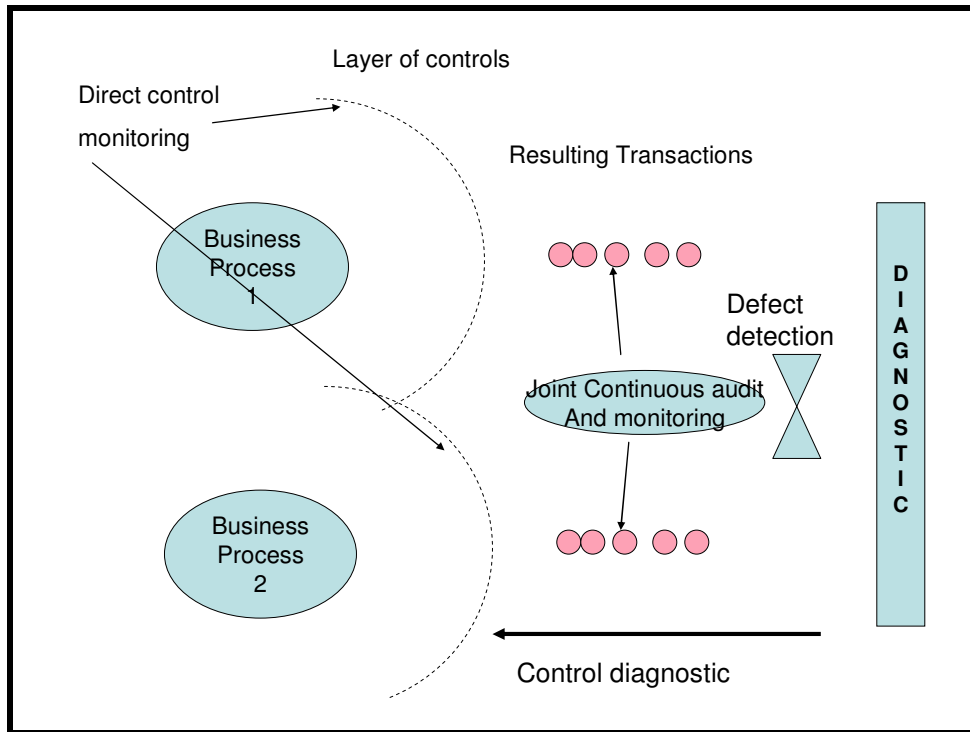


Figure 14: CA & CCM multiple data strings

Figure 13 is expanded by Figure 14 adding a second related process. For example business process 1 could be sales and business process 2 inventory provisioning. Both processes have their own layers of control and some control communality. While some degree of direct control monitoring is possible, and progressively more controls get automated and can be monitored, many are not. Furthermore there will always be deficiencies for which controls do not exist or have not been implemented. Business.

If controls are not observable or monitorable they must be examined by observing downstream data streams and observing faults that would indicate non-operational control.

c. The issue of control combinations and aggregate effectiveness

Internal control is a process which is effected by an entity's board of directors, management, and other personnel and which is designed to provide reasonable assurance regarding the effectiveness and efficiency of operations, the reliability of financial reporting, and compliance of the organization with laws and regulations (COSO, 1992). The importance of effective internal controls has long been recognized. Effective internal control can help companies achieve established financial goals, prevent loss of resources,

keep accurate recording of transactions, and prepare reliable financial statements (Ernst & Young 2002). The recently enacted Sarbanes-Oxley Act of 2002 (the Act) forces renewed attention to internal controls over financial reporting. The act makes reporting on internal controls mandatory for SEC registrants and their independent auditors. Section 404 of the Act directs the SEC to adopt rules requiring annual reports of public companies to include an assessment, as of the end of the fiscal year, of the effectiveness of internal controls and procedures for financial reporting. Section 404 also requires the issuer's independent auditors to attest to and report on management's assessment. Section 302(a) of the act requires that the CEO and CFO must assess the effectiveness of the issuer's disclosure controls and procedures, of which internal controls over financial reporting are a part.

In issuing an opinion on the internal controls of a firm we must be able to identify the controls that exist, and comprehend the resulting effectiveness of the package of controls. We currently do not know how to do this.

C. Conclusions

This paper aims to formulate a series of concepts on which to base the future world of corporate monitoring and assurance. These concepts, within the frames of a real-time economy, impound modern technology into the world of corporate reporting and assurance.

The modern corporate control and monitoring environment is seen at 5 level: 1) structural, 2) data, 3) relationship, 4) analytic monitoring, and 5) the continuous reporting and assurance level. In order to perform continuous audit (assurance) five basic concepts are used: 1) metrics, 2) standards, 3) analytics, 4) alarms and 5) method of measurement and monitoring.

Corporate business processes are monitored by the processes described above. Operation feedback processes that compare actual metrics with standards and evaluate the variance to decide on operations adjustments and/or alarms keep processes in balance. The quest for latency reduction highly favors the automation of these feedback processes, Continuous assurance is a secondary user of the same feedback processes.

In this world of balkanization of data, where data flows among value chain connected processes (outsourced, tertiary or internal) the integrity of data, processes or organizations is dependent on good control and assurance processes. Consequently three levels of assurance are targeted: 1) data level assurance, 2) process level assurance, and 3) opinion level assurances. For these assurances to be performed CA and CCM

processes must be performed and cooperate with a new set of internal and external business measurement processes⁴. In the real time

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